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INSTRUCTION MANUAL

YC-355

YAESU MUSEN CO., LTD.

INSTRUCTION BOOK
FOR
YC-355 FREQUENCY COUNTER

Yaesu Model YC-355, frequency counter is of compact design, light weight and completely self-contained instrument, using advanced I.C. techniques to enable counting of a wide frequency range 5 Hz to 35 Mhz.

Dual range system provides 8 digit measurement with Mhz or Khz indications. Double-sided epoxy circuit board helps to ensure stable and accurate service for many years.

FREQUENCY COUNTER YC-355

Specifications

Frequency range	:	5 hz - 35 Mhz
Accuracy	:	± time base stability + 1 count
Number of digits	:	5 digits
Gate time	:	1 milli-sec. and 1 sec.
Indicating time	:	0.1 sec. or 1 sec.
Display units	:	Khz and Mhz
Input voltage	:	20mv - 20v p-p continuous 60v p-p for 10 sec.
Input impedance	:	1M ohm/50 ohm
Input capacitance	:	less than 20 pf
Clock crystal	:	1.000 Mhz
Stability	:	± 0.0005% at 25°C ± 0.0025% 0°C - 40°C
Operating temp.	:	0°C - 40°C (approx. 30°F - 90°F)
Power requirements	:	[A.C.] 100/110/117/200/220/234v 50/60 hz 18vA.
Dimensions	:	220W x 80H x 270D mm
Weight	:	3.5 kgm (8 lbs)
Tube & semi-conductors	:	I.C. 25
		Silicon transistor 6
		F.E.T. 1
		Diode 9
		Display tube 5

* Specifications subject to change without notice.

Parts List

Parts	Function	Type	Qty.
Tube	display tube	B-5870S	5
Diode	regulator	1S993	1
	input	1S1555	2
	HT rectifier	1S1944	4
	LT rectifier	V06B	2
FET	input amp.	2SK19GR	1
Transistor	regulator	2SC372Y	1
	"	2SC735Y	1
	input amp.	2SC784R	2
	over-range neon driver	2SC869C	1
	regulator	2SD317Q	1
I.C.		SN7400N	2
		SN7404N	1
		SN7441N	5
		SN7473N	1
		SN7475N	5
		SN7490N	11
Neon	over-range indicator		1

Accessories

* Signal test lead 1 meter long with BNC connector and clips
* 1A fuse for A.C. - (1)

YC-355 Front Panel controls

OVER

This is an over range indicator which will flash on when the input frequency is above 100 Khz when the range switch is in the KHZ position.

POWER

Power on/off switch.

RANGE

The frequency range switch should normally be at KHZ for frequencies below 99.999 Khz and at MHZ for frequencies above 100 Khz. In the KHZ position the digits to the left of the decimal point are Khz and to the right Hz. In the MHZ position the digits to the left of the decimal point are Mhz and to the right Khz.

LOW/HI

This switch selects the input impedance of the counter.

LOW	50 ohm
HI	1M ohm

INPUT

BNC connector accepts the plug on the test lead.

Operation of YC-355

The frequency counter is designed to operate at temperatures between 30°F - 90°F (0° - 40°C). It is not wise to operate at temperatures outside this range if accurate readings are required.

Do not use the counter in bright sunlight, even if the ambient temperature is within this range.

The YC-355 may be operated from 100/110/117/200/220/234 volts AC when appropriately wired but is normally supplied for 117 volts AC. Therefore, before connecting AC cord to the power outlet, be sure that the voltage marked on the rear of the counter agrees with the local AC supply voltage.

CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER AC SUPPLY VOLTAGE IS APPLIED TO THE COUNTER.

Frequency measurement

Before plugging into power source make sure that the power switch is off.

When the power is turned on, the numeric display should show 5 zeros.

Connect the measuring cable to the input connector and attach clip leads to the measuring point; black is ground. Select the appropriate input impedance and frequency range.

The maximum input voltage is 20v p-p for continuous operation and 60v p-p for 10 seconds max. The DC input rating is 500v.

If the signal to be measured has an amplitude greater than 20v p-p, use an attenuator for continuous operation. If the DC component exceeds 500v use a high voltage capacitor of 0.01uF in series with input.

Reading frequency

Although the YC-355 has 5 numerical indicators it is possible to read to 8 digit accuracy.

If the counter is on the MHZ range and the indicators show 12.346 Mhz. then the actual frequency is between

12.345 and 12.346. If the range switch is set to KHZ then the next 3 digits can be read off, e.g. it may now show 45.678 Khz. Then the actual frequency is 12.345678 Mhz, however the last digit will be one count in error, i.e. the last digit is either 7 or 8.

Input impedance

The input impedance can be changed by a switch on front panel to minimise the effect of the counter on the circuit measured. HI position may be used to minimise the loading on the circuit and LOW position may be used to minimise stray pick up.

Over range lamp

The over range lamp will flash on and off if the input frequency is greater than 100 Khz when operating in the KHZ position. No damage will be done if the counter is operated continuously under over range conditions, the lamp merely indicates that the true frequency is not being fully displayed but may lack the first 3 digits.

Measuring distorted waveforms

If the signal to be measured has some harmonic content, then depending on the input level the counter may show the fundamental or the harmonic frequency.

Error

When measuring frequency with a frequency counter there are always errors inherent in the system which cannot be avoided.

There are two possible sources of error:

(1) Standard marker generator error.
(2) Counting error associated with the input gate.

The first error results when the frequency of the marker generator crystal changes due to temperature or aging. The counter operates by counting the number of pulses of the input signal which passes through the gate for a set period of time. In this counter gating time is 1 Milli sec and 1 sec, which is controlled by the 1 Mhz crystal. If the crystal frequency increases by 1%, the gate time is reduced by 1% which causes a -1% error in indicated frequency.

In the YC-355 the crystal accuracy is ±0.0025% which represents an error of ±750 Hz at 30 Mhz. (But, on normal temp., about 1/5 of this error (±150 Hz).

The second error is always present and is called as one count error. This error results when the gate opens just before a pulse or just after a pulse and causes an error of +1.

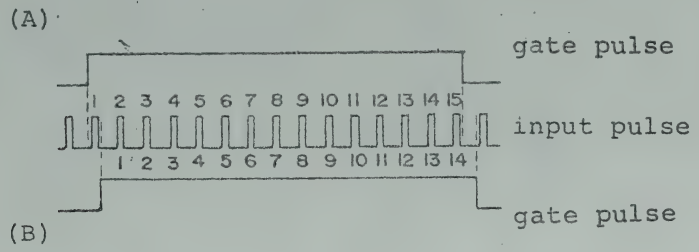
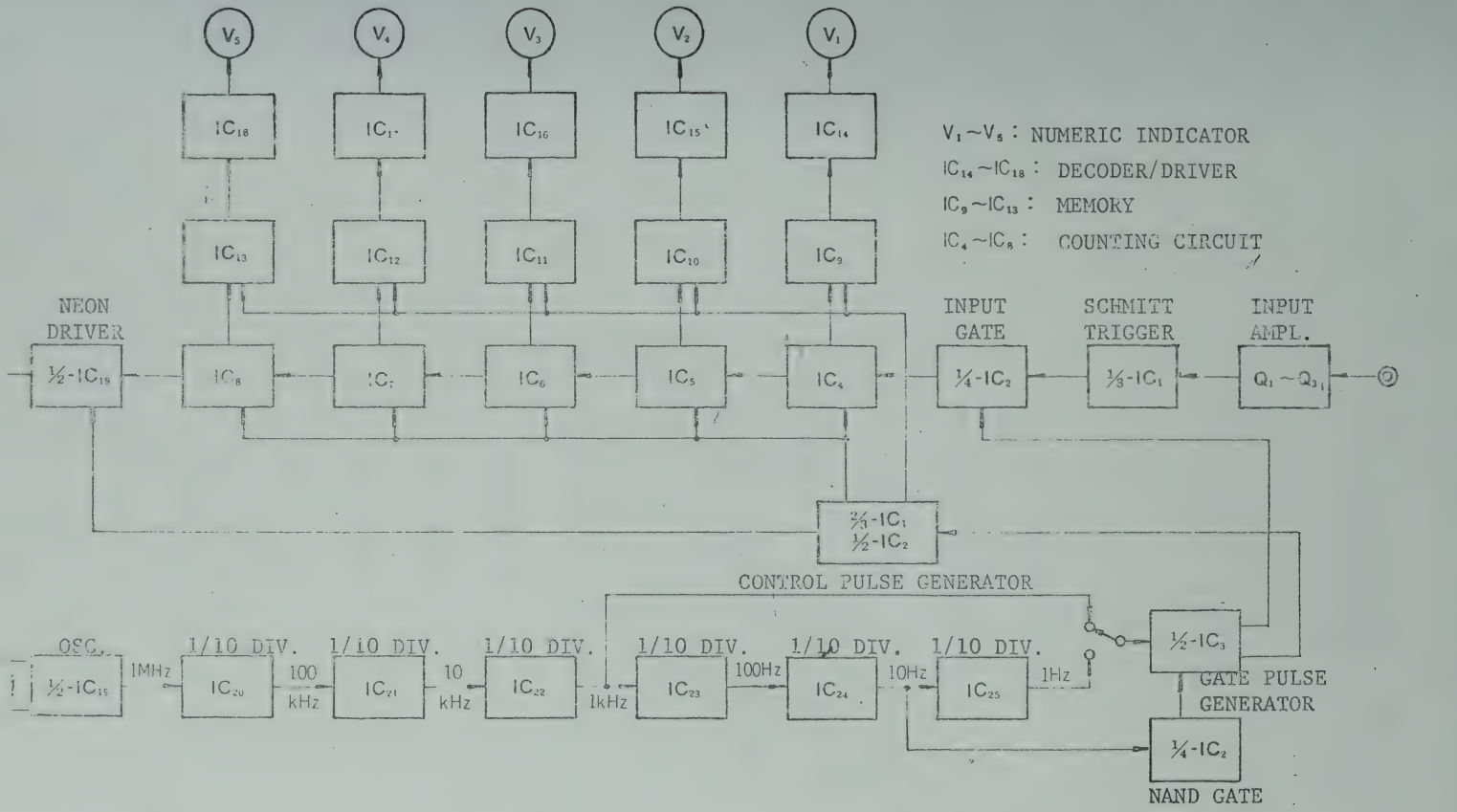


Fig. 1

Because the counter counts the number of pulses that pass through the gate then if the gate opens as in the top drawing (A) the counter will count 15 pulses. If it opens as in the bottom drawing (B) it will count 14 pulses, although the frequency is the same.

The last digit only has this error, hence on the YC-355 the error is +1 hz on the KHZ range and +1 Khz on the MHZ range.

This error must be considered when measured frequencies only occupy the first two digits on either range.



Block Diagram

$V_1 - V_5$	: numeric indicator tubes
$IC_{14} - IC_{18}$	: drivers for $V_1 - V_5$, binary coded number change to decimal number
$IC_9 - IC_{13}$	: memory
$IC_4 - IC_8$	: counting circuits
1/2 IC_{19} Q_4	: over range neon driver
$Q_1 - Q_3$	: input amplifier
1/3 IC_1	: schmitt trigger
1/4 IC_2	: input gate
2/3 IC_1, 1/2 IC_2	: control pulse generator
1/2 IC_3	: gate pulse generator
1/2 IC_{19}	: 1 Mhz crystal oscillator
$IC_{20} - IC_{25}$	: clock divider chain $\div 10^6$
1/4 IC_2	: NAND gate
1/2 IC_3	: $\div 2$ flip flop
D_7, D_{10}	: HT rectifiers
D_5, D_6	: LT rectifiers
$Q_7 - Q_9$, D_3	: LT regulator

The binary coded decimal output from IC_4 - IC_8 is fed to IC_9 - IC_{13} which are buffers and also perform the memory function. The memory is required to prevent the numeric indicators from following each count when the gate opens. The result is that the frequency measured in one count is held in the indicators while the next count is being made, then they change when the count is completed.

The outputs from IC_9 - IC_{13} (still binary coded decimal) is fed to IC_{14} - IC_{18} which convert the B.C.D. into decimal numbers and select the necessary cathode in the indicator tubes to show a particular number.

If the number of pulses passing through the gate is greater than 10^5 then this exceeds the counting capacity of the count circuit. The overflow from IC_8 is fed to 1/2 IC_{19} and Q_4 which form the over range indicator circuit. This circuit turns the neon on for approx. 200 Milli-sec and is reset before the next count.

The standard time oscillator (clock) is composed of the 1 Mhz crystal oscillator 1/2 IC_{19} and IC_{20} - IC_{25} divider chain. The divider chain is the same as the counting chain except that only the divide by 10 facility is used. This chain uses 6 IC's with a total division of 10^6. Outputs are taken of at 1 Milli sec (1 Khz), 10 Milli sec (100 hz), 100 Milli sec (10 hz) and 1 sec (1 hz).

The pulse generator is composed of 1/4 IC_2, 1/2 IC_3 and 2/3 IC_1, 1/2 IC_2 generates pulses to reset the counting IC's, to control the memory and to open the input gate. Refer to the diagram to aid explanation.

The range switch selects the drive frequency from the standard time generator which is fed to the clock input of IC_3. The output from pin 12 is either pulses of 1 Milli sec width or 1 sec width which open the gate in IC_2. However in the MHZ position the gate is opened 500 times every second, thus the display would change 500 times/second. This would make it difficult to read the last few digits especially.

This problem is overcome by feeding the 10 hz clock signal through the invertor IC_2 and into the J input of IC_3. This limits the count rate to one every 100 Milli sec while still maintaining a count time of 1 Milli sec on the MHZ range.

The pulse from pin 13 of IC_3 is fed to IC_2 and IC_1 which produce pulses for the following purposes.

Approximately 4 Micro-sec after a count is completed a pulse 1 Micro-sec wide appears at pin 8 of IC_1, this pulse is fed to the memory IC's (IC_9 - 13). The pulse opens the memory for 1 Micro-sec during which time, the value of the count is stored and fed to the indicators.

Transistor Voltages

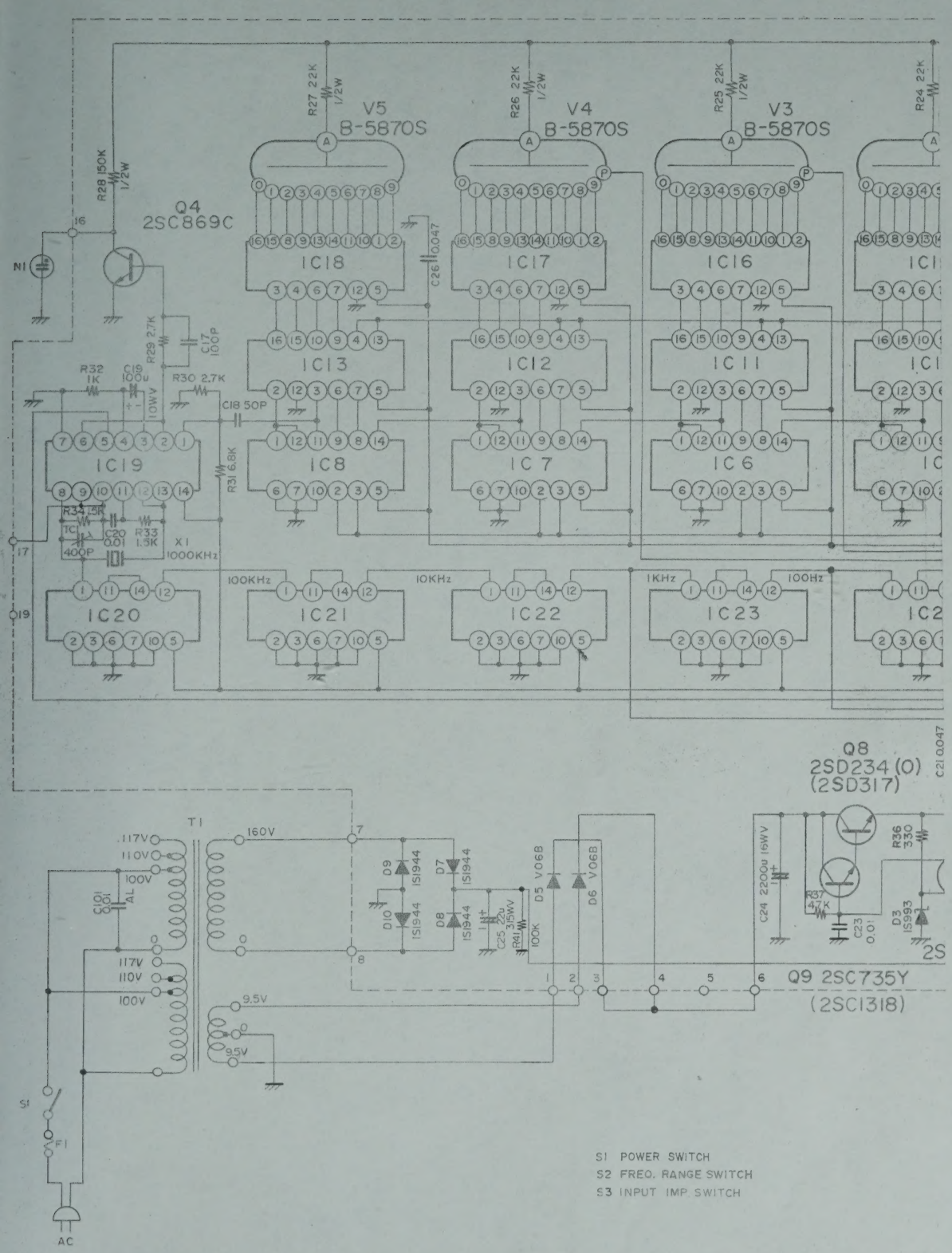
measured with V.T.V.M.

	Q1	Q2	Q3	Q4	Q7	Q8	Q9
Col/ Drain	4.35	3.35	2.65	0	6.5	8	8
Base/ Gate	0	1.2	1.5	0.65	3.8	5.8	6.5
Emit/ Source	1.25	0.45	0.75	0	3.2	5.0	5.8

for any given unit values should be within $\pm$20%.

NOTES:
1. ALL RESISTORS IN OHM 1/4W ±10% UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS IN uF UNLESS OTHERWISE NOTED.

YC-355
SCHEMATIC DIAGRAM



S1 POWER SWITCH
S2 FREQ. RANGE SWITCH
S3 INPUT IMP. SWITCH